Maine Stream Team Program
NEWS

Networking, Education, and Stewardship

Volume 6 Issue 1 Winter 2006

Linking Ground Water and Streams

Some of the most valuable resources the state of Maine has to offer are its miles of rivers and streams. As we study rivers, though, we tend to forget how little of the water on this planet is found in them. Water in rivers makes up only 2% of all fresh surface water on this planet. (Lakes and wetlands make up the rest.) Surface water itself makes up less than one half of one percent of all *fresh* water.

Where is the rest of that fresh water? More than two-thirds of it is frozen in glaciers and ice caps. Almost all of the rest is ground water. That means that for every cup of water in a river or stream, there are around 300 gallons of water in the ground!

In this country, more than 50% of people rely on ground water for drinking water. In Maine, an average of 60% of people use ground water, but that climbs to 90% of people in rural areas. Clearly we have a vested interest in protecting ground water for our own consumption. But ground water is also very important for rivers and streams as well.

Ground water basics

In order to understand the importance of ground water to streams, it is important first to know a little bit about ground water. Ground water is, as the name implies, water in the ground. It is found in the tiny pore spaces between grains of sand and in the fractures of bedrock. Water gets into the ground primarily from infiltration of precipitation and "leaking" surface waters. (What do you imagine would happen if you tried to build a swimming pool out of coarse sand and gravel and then tried to fill it with water?)

Near ground surface, the pore spaces are mostly filled with air. As you go deeper underground, more of the pore spaces are filled with water, until eventually (when you reach the *water table*) they are all filled (Figure 1). The zone below the water table is called the *saturated zone*, so named because the pore spaces are entirely saturated with water.

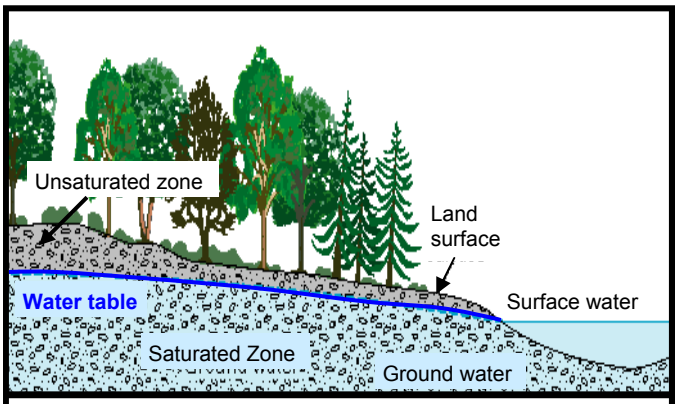

Figure 1. Basic ground water terminology. *(From USGS Water Science for Schools webpage.)*

Within the saturated zone are *aquifers*, layers of sand and rock through which ground water flows easily. These tend to be layers with larger, well-connected pore spaces, such as sands, gravels, and highly fractured bedrock. On the flip side, layers with smaller and less-connected pore spaces, such as clay, tend to impede ground water flow and form the boundaries of aquifers.

(Continued on next page)

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Linking Ground Water and Streams, cont.

Streams and ground water

So how does ground water interact with rivers and streams? On a large scale, regional ground water flow directly affects streams. Depending on the elevation of the water table relative to a section of a stream, ground water will either discharge into a stream or be recharged by a stream. A stream segment being fed by ground-water is termed a "gaining" segment, and one losing water to the ground is called a "losing" stream segment (Figure 2). The conditions of a given reach may vary seasonally.

Ground water has several important impacts on streams, particularly for gaining streams. Many streams which lack base flow from runoff would dry up in the summer without input from ground water. This ground water has the added benefit of being cool, allowing cold-water-adapted organisms to survive. Since they are hydraulically connected, the chemistry of the ground water will affect the chemistry of a gaining stream.

On a more local scale, ground water interacts with streams through the *hyporheic zone*. This is the area beneath stream and river channels and floodplains where mixing of surface and ground water occurs. In these zones, water moves in and out of the subsurface in paths ranging from centimeters to kilometers within the river floodplain.

The hyporheic zone serves several important functions. As a transition zone between surface and ground water, it provides habitat for species native to both (see the Critter Corner article, page 3). Since the water has higher contact time with the sediments, hyporheic zones also have a great impact on nutrient cycles and potentially the removal of pollutants within streams.

Recognizing the connections between ground water and streams highlights the importance of efforts to improve both ground water and surface water quality. Some simple actions you can take to protect both of these resources include: limiting the use of lawn chemicals; not dumping chemicals or other household products on the ground; properly maintaining septic systems; seeding and stabilizing areas of bare soil; and conserving naturally vegetated/forested areas that buffer/soak-up the runoff from our yards.

This time of year, we can also make an effort to apply salt in modest amounts, only to driveways and parking lots where we expect people to walk. This is a way to ensure people's safety while minimizing the contamination of ground water and surface waters.

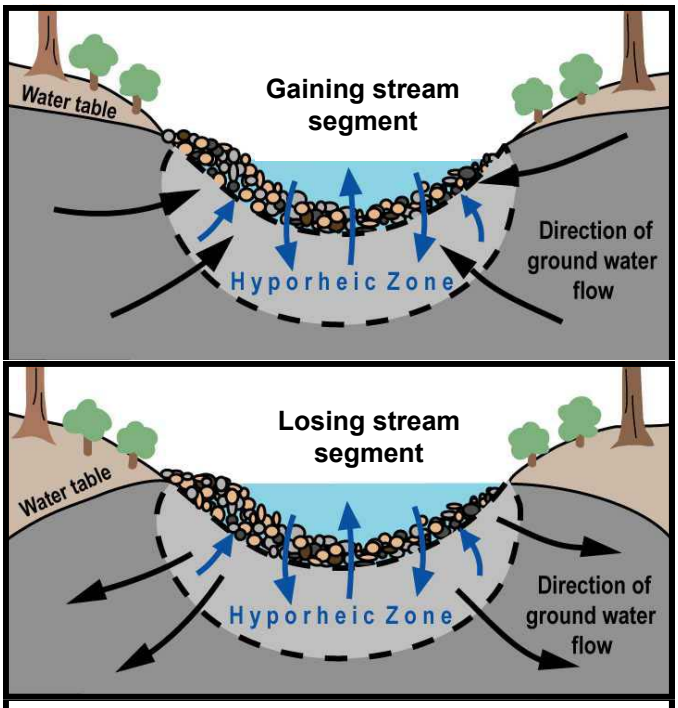

Figure 2. In both of these stream segments, water circulates within the hyporheic zone. Where the water table elevation is higher than the stream elevation, regional ground water flow discharges into the stream (a "gaining" stream). Likewise, when it is lower than the stream elevation, the aquifer is recharged by the stream (a "losing" stream). (Figure adapted from Winter et al., 1998)

References

University of Maine - Senator George J. Mitchell Center - digest series webpage, various ground water publications, < http://www.umaine.edu/WaterResearch/outreach/digest_series.htm >.

USGS Water Science for Schools webpage, < http://ga.water.usgs.gov/edu/mearth.html >.

Winter, T. C., Harvey, J. W., Franke, O. L., and Alley, W. M., 1998, Ground water and surface water - A single resource: U.S. Geological Survey, Circular 1139, < http://pubs.usgs.gov/circ/circ1139/ >.

Critter Corner: Hyporheos

Water in river and stream channels moves back and forth between surface water (what you see in the stream) and ground water adjacent to and beneath the stream. The region of the subsurface which swaps water with a stream is called the *hyporheic zone*. The hyporheic zone has been shown to play an important role in stream chemistry (Harvey 2000), but also provides habitat for a number of invertebrates categorized as "*hyporheos*".

The hyporheos is comprised of a diverse group of invertebrates that spend at least part of their life cycle in the hyporheic zone. This unique region contains a range of critters originating from "true" ground water and surface water environments.

The majority of hyporheos are occasional occupants. Some of them spend time in the hyporheic zone during a juvenile stage. Others ride out the harsh conditions of flooding or drying out of a stream in the hyporheic zone. Still others, whether true stream or true ground water invertebrates, find themselves in the hyporheic zone accidentally.

Only a small percentage of hyporheos are "permanent" residents of the hyporheic zone. Some of them have maintained adaptations for survival in surface waters (e.g. pigmentation and sensitive eyes) which allow them to survive in a stream if necessary. These critters only visit surface waters briefly. Some examples include some members of the sallfly (Chloroperlidae) family of stoneflies (Plecoptera), and seed shrimp (Ostracoda).

The distribution range of hyporheos can be surprising. For example, stoneflies known to spend at least part of their lifecycles in rivers in northwest Montana were discovered in drinking water wells up to 2 km away from river channels in one study (Stanford et al., 1994).

Paraperla sp. nymph, a hyporheic stonefly species found in Montana. (Photo taken by C. Riley Nelson.)

Within a stream reach, two factors influence the distribution of hyporheos: sediment and reach characteristics. The type of sediment in the hyporheic zone controls the pore size (the space between individual grains), the velocity of water moving through those pores, and the availability of energy in the form of biofilms (microbes or microorganisms; the "grass" of the hyporheic food chain) and other prey.

At the reach scale are zones of upwelling and downwelling water. In areas of upwelling, typically the upstream end of pools, you would more likely find abundant obligate hyporheos and "true" ground water critters. In regions of downwelling, typically the upstream end of riffles, you would more likely find occasional hyporheos and "true" stream critters.

Hyporheic zones and organisms have been documented in many types of streams and rivers around the world. Some limited research confirms the existence of these habitats and organisms in certain stream types in the northeastern U.S. (Strayer et al., 1995; Boulton, 2000).

The diversity of hyporheic communities has been shown to be related to glaciation patterns in North America; hence Maine would be expected to have a lower diversity of hyporheos than Alabama (Strayer et al., 1995). More research is needed here to determine the relative contribution of hyporheic zones to local streams and rivers in Maine.

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Harvey, J.W., and Wagner, B.J., 2000. Quantifying hydrologic interactions between streams and their subsurface hyporheic zones. In J. Jones & P. Mulholland (Eds.), Streams and Ground Waters, pp. 3-43: Academic Press, Orlando.

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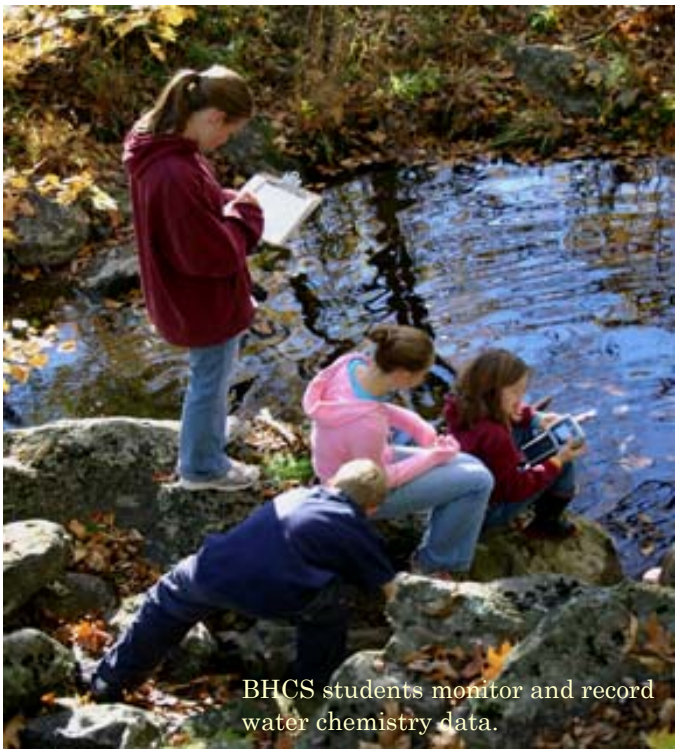
MERI Program Turns Local Students into Watershed Investigators

BLUE HILL—Young science students became active investigators of the Blue Hill watershed this past fall as they participated in a new and exciting environmental education program recently begun by the Marine Environmental Research Institute (MERI) in Blue Hill.

The initiative, which aims to teach local students about natural processes and human activities affecting the watershed, offers hands-on learning about water quality, phytoplankton (red tide), point and non-point-source pollution, the land-sea connection, geomorphology, bacteria, macroinvertebrates, lab equipment, and mapping.

The new education program is multi-faceted and designed to be held in the classroom, in the field, and in the MERI labs. In September 2005, MERI began working with 7th and 8th grade science classes from the Blue Hill Consolidated School (BHCS) on a six-week "investigative" monitoring program at the Mill Stream.

MERI also involved high school students from Liberty School in three events: a marine debris cleanup on an island in Blue Hill Bay, a phytoplankton (red tide) workshop in the MERI research laboratories, and a discussion on site monitoring and human impacts on the watershed. MERI's Education Department is currently designing watershed curricula for elementary, middle and high school science classes to compliment the hands-on aspect of the program.



BHCS students monitor and record water chemistry data.

Monitoring

BHCS students measured three physical parameters: pH, dissolved oxygen, and temperature. The students chose to monitor two sites, one in the stream and one in a small pool of water next to the stream, but not completely connected. Their tests showed the main stream site to be in good condition, but the pool of water was very low in dissolved oxygen.

During the time of the program, Blue Hill experienced many days of heavy rain which ended up connecting the pool of water to the stream. Quickly the dissolved oxygen levels rose to meet those of the stream. This was fantastic for the students to see and helped them understand the roles each of their parameters played in creating a healthy environment.

Along with monitoring these parameters, the students conducted other tests to determine the health of the stream. They monitored the stream for macroinvertebrates using a kick net to gather organisms and then sorted them out to determine the health of the stream. Fortunately, the Mill Stream was discovered to be healthy based on this study.

In the classroom, the students studied pH in more detail and learned about the importance of dissolved oxygen and the role temperature plays in the health of a stream. Using a watershed model, they then learned about point and non-point source pollution and how it impacts the entire watershed.

Storm Water Runoff

While mapping the stream system, students discovered that many storm drains flowed into the stream. Classes followed the small pool back to see where it was coming from and found it came out of a storm drain. Using their detective skills they followed the storm drains back through the parking lot and playground to a small stream at the other side of the school.

MERI Program, cont.

In one of the drains they saw that someone had dumped red paint, other drains were in parking lots with oil stains or were near fertilized fields. Now they knew that anything that went into the drains went directly into the stream. Students decided that they should stencil the storm drains to read "Dump No Waste – Drains to Bay" to let the public know that they should not dump anything down the storm drains.

BHCS Students stencil the storm drains.

The students continued following the stream to the harbor where they discovered more than 70 ducks living near the mouth of the stream. Students decided to test the water for bacteria at the MERI Water Quality Laboratory. The results from the test indicated the water had fecal coliforms and *E. coli* present.

Lessons Learned

During the final week of the program, the students learned about the work that MERI does through its ongoing watershed monitoring project. They graphed the data they collected and compared it to the graphs MERI has for the same stream.

What they discovered as a result of their investigation was a drop in temperature due to the season and a rise in dissolved oxygen in the pool. Students were then invited to assist MERI staff with monitoring in the spring.

The new education initiative was born out of MERI's ongoing monitoring programs in Blue Hill. For two years, MERI's research staff has been monitoring water quality, nutrients, and bacteria at 17 marine and fresh water sites in the watershed. MERI has also been monitoring red tide at sites in Blue Hill and Brooklin in conjunction with the state's *Maine Coastal Program*.

A major goal of the new school program is to teach local students about human impacts on the watershed and to engage them in activities designed to protect it.

For more information on this MERI school program and other educational activities, visit < http:// www.meriresearch.org >, call (207) 374-2135, or email lpaddock@meriresearch.org. This article was adapted from a submission by MERI.

$$ Grant Opportunities $$

For more comprehensive results, we refer you to the recently updated New England Environmental Finance Center Network Directory of Watershed Resources at: < http://efc.muskie.usm.maine.edu/tools.html >. The Directory is a free, searchable database of environmental funding programs and other support. It provides up-to-date information on assistance available from federal and state government, private foundations, corporations and other organizations. The directory has just been updated to include nearly 300 programs with a New England focus, and includes over 320 national funding/assistance sources as well. Programs listed in the Directory support a wide range of environmental activities including watershed restoration, land conservation, capacity building and education. The Directory includes over 600 Federal, State and Private funding and assistance programs for which New England organizations are eligible to apply.

Funder	Region	Deadline(s)	Phone	Contact Address/Web Site (W)/Email (E)
Coastal Counties Restoration Initiative	National	Feb 24		www.nfwf.org/programs/ccri.cfm
Gilbert and Ildiko Butler Foundation	Northeast (ME preference)	None	(212) 980-0606	

Calendar Items

Penobscot River Seminar Series
The goal of this seminar series is to provide information on current research projects taking place on the Penobscot River ahead of the proposed dam removals. Meet at noon at Norman Smith Hall at the University of Maine campus in Orono. The first few are as follows:

FEBRUARY 2, 2006. Topic: NOAA Salmon Research in the Penobscot River, Estuary, and Bay; Speaker: John Kocik, NOAA Fisheries.

FEBRUARY 9, 2006. Topic: Atlantic Salmon Management in the Penobscot Drainage; Speaker: Joan Trial, Atlantic Salmon Commission.

THURSDAY, FEBRUARY 16, 2006. Topic: Biological Assessment of Rivers and Streams in the Penobscot River Basin; Speaker: Tom Danielson, Biomonitoring Unit, Maine Dept. of Environmental Protection

For additional dates and more information, see: < http://www.umaine.edu/waterresearch/outreach/lecture_series.htm >.

Forum on Sprawl, Smart Growth, and Getting Involved
MARCH 1, 2006. Learn how town management works and how citizens can get involved and have input into the decision-making process. The emphasis of the forum will be on sprawl, smart growth, planning, and quality of life issues in the Ellsworth area, but this information may be applicable to other watersheds. This event is being organized by the Union River Watershed Coalition (URWC) and Coastal Hancock Healthy Communities. More details on the event will be posted on the calendar page of the URWC's website < http://www.unionriver.org/ > as the date approaches.

Maine Water Conference
MARCH 22, 2006. Augusta Civic Center, Augusta, Maine. For more information, visit < http://www.umaine.edu/WaterResearch/mwc/index.htm >.

New England Association of Environmental Biologists (NEAEB) - Annual Meeting
MARCH 29-30, 2006. Bethel Inn, Bethel, Maine. Information updates and registration materials will be posted at < http://www.epa.gov/NE/neaeb2006/index.html >.

Maine Environmental Education Association Conference
APRIL 7, 2006. Chewonki Center, Wiscasset, Maine. See their website at: <http://www.meeassociation.org/>

Conservation Expo
APRIL 19, 2006. University of Maine at Farmington, Farmington, Maine. To register, or for more information, contact the Franklin County Soil & Water Conservation District at 778 - 4279.

National River Rally 2006
MAY 5-9, 2006. This national river conference will be held in Bretton Woods, NH. See < http://www.rivernetwork.org/rally/ > for more details.

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Announcements

USEPA Funded Targeted Watershed Initiative Projects in Maine

The U.S. Environmental Protection Agency announced in late 2005 that the Casco Bay Estuary Partnership and the Presumpscot River Watershed Coalition were awarded approximately $740,000 for watershed education, monitoring, and protection efforts. Briefly, the **Presumpscot River** Watershed Initiative will implement a suite of projects to improve water quality, enhance riparian habitat, reduce contaminant (e.g., sediment, bacteria, nutrients, and toxins) loading, and foster increased stewardship and awareness among inhabitants within the Presumpscot River watershed. Demonstration projects will model land stewardship practices to watershed landowners and land users. Project partners will monitor water quality parameters and use educational outreach to actively engage multiple watershed stakeholder groups. For additional information visit < http://www.epa.gov/owow/watershed/initiative/ >.

In 2003, watershed conservationists in the **Meduxnekeag River** Watershed were awarded a similar grant. One of the highlights of the project includes a winter (cropland) cover conservation program for local farmers. In short, these conservation practices stabilize otherwise bare potato fields during the winter. These practices – planting winter cover crops and mulching fields with hay or straw - help keep productive agricultural soil on the farm and out of the Meduxnekeag River. In 2003, only four farmers used these practices on a total of 285 acres; the estimated soil saved was 92 tons. One year later, 15 farmers are using the practices on 1,809 acres, saving an estimated 542 tons of soil from moving into the river! For more information, check out the Maine Rivers News (Fall 2005) summary at < http://www.mainerivers.org/news.html >.

New PEARL Available (A Maine-Focused Water Quality Database Website)

After many months of hard work by Mitchell Center staff, students, and collaborators, the new PEARL website is up and running. With added information on streams, wetlands, coastal and terrestrial ecosystems, biodiversity, recreational access, as well as educational resources and summary information, PEARL is great source for environmental information in Maine. Started in 1996 as "Public Educational Access to Resources on Lakes", PEARL has evolved into a multi-disciplinary data access and bibliographic resource. PEARL is home to quality-assured data files from state agencies, partner organizations, and individuals. PEARL data are accessed via text- or map-based searches by waterbody, town, county, or even watershed name. To access the website visit < http://www.pearl.maine.edu >.

Maine Atlantic Salmon Habitat Analysis Completed!

The U.S. Fish and Wildlife Service's Gulf of Maine Coastal Program and the Maine Atlantic Salmon Commission are pleased to announce the publication of the second edition of the Maine Atlantic Salmon Habitat Atlas. The Atlas provides detailed maps of Atlantic salmon spawning and rearing habitat along 15 rivers in Maine including the Aroostook, Dennys, Ducktrap, East Machias, Kennebec, Machias, Narraguagus, Passagassawakeag, Penobscot, Pleasant, Presumpscot, St. George, Sheepscot, Tunk and Union Rivers. This second edition of the Atlas is available in PDF files for standard viewing, and in ArcView Shapefile format for those with GIS capabilities. The PDF files in the Atlas are available from the Maine Office of GIS website at < http://apollo.ogis.state.me.us >. First, select "Maps," find the "Maine Atlantic Salmon Habitat Map Series," then select the watershed of interest to you. You can view the data directly from the website, but if you are interested in frequently accessing data for a specific river system, you will want to download the information for quicker access. To get the actual GIS data, please contact Alex Abbott c/o Gulf of Maine Coastal Program, U.S. Fish and Wildlife Service (207-781-8364) or the Maine Atlantic Salmon Commission (207-941-4449).

Be Careful When Traveling On Ice!

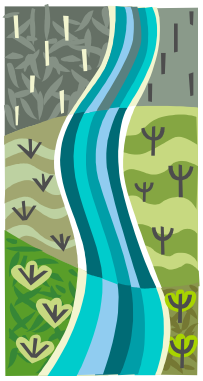
For safety tips regarding ice conditions, visit < http://www.state.me.us/ifw/fishing/regulations/icefishing.htm >.

Announcements, cont.

Volunteer Maine Partnership Database Website Available
Search for or list volunteer opportunities by visiting < http://www.volunteersolutions.org/uwgp/volunteer/ >.

Atlantic Salmon Recovery Plan Released by the Federal Government
Approximately five years after Atlantic salmon were declared endangered on eight Maine rivers, federal regulators have released a recovery plan aimed at restoring salmon runs from the Kennebec River to the Canadian border. The rivers of concern include the Dennys, East Machias, Machias, Narraguagus, Pleasant, Ducktrap and Sheepscot rivers, along with Cove Brook, a tributary of the Penobscot River. The document presents recommended recovery actions, beginning with better protection of salmon habitat. It also describes 13 threats ranging from acid rain to aquaculture operations off the coast of Maine and New Brunswick. In 2000, biologists said wild salmon numbers were at an all-time low with only about 300 mature salmon returning to the eight targeted rivers. By 2002, the estimated number dropped to between 23 to 46. In 2004, it was between 60 and 113 fish. To view the plan, visit < http://www.nmfs.noaa.gov/pr/recovery/#fishes >.

Maine's Stormwater Laws, Rules, and Best Management Practices (BMPs) Manual Revised in 2005
For information on these updates and resources, visit:
< http://www.maine.gov/dep/blwq/docstand/stormwater/index.htm >.



Don't Over-Salt Your Walkways, Parking Lots, and Roads This Winter

Please apply salt to walkways, driveways, and parking lots only in modest amounts on places where you expect people to walk or drive. This way you ensure peoples' safety while minimizing the contamination of groundwater and surface waters. There is increasing evidence that freshwaters of the northeastern United States are becoming saltier, which threaten to degrade aquatic habitats and drinking water supplies. A recent journal article stated that: "We observed chloride concentrations of up to 25% of the concentration of seawater in streams of Maryland, New York, and New Hampshire during winters, and chloride concentrations remaining up to 100 times greater than unimpacted forest streams during summers ..." (Kaushal et al. 2005; Sept. 20, 2005 issue, Proc Natl Acad Sci; http://www.pnas.org/cgi/doi/10.1073/pnas.0506414102).

MDOT Fish Passage Policy and Design Guide Available
The 2nd Edition (2004) version of this guidance document is available at < http://www.maine.gov/mdot/environmental-office-homepage/other_environmental.php >.

Sediment Assessment Methods Website Completed

The Office of Water recently finalized a new technical methods website designed to help watershed managers assess and restore waters with suspended or bedded sediment problems. The centerpiece of the WARSSS website (Watershed Assessment of River Stability and Sediment Supply) is a step-by-step, three-phase assessment methodology developed by Dr. David L. Rosgen for detecting sediment problems and source areas, estimating excessive sediment loads, and planning to restore normal sediment dynamics in streams and rivers. Besides the WARSSS methodology, the site also contains the entire sediment model WRENSS, a stream classification tutorial, and a large collection of links to clean sediment information and tools. Visit the WARSSS website at < http://www.epa.gov/warsss >.

Archive of Information on Riparian Zones (Streamsides/Shorelands), Forested Buffers, Woody Debris, and Stream-Friendly Landscaping Available

Check it out at < http://www.maine.gov/dep/blwq/docstream/team/riparian.htm >.

Maine Stream Team Program
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Portland, Maine 04103

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How Do I Join the MSTP?

It's easy! First, choose a stream or stream segment. Next, obtain a "stream team registration form" by contacting us, or simply fill out the online registration form. After registering, you will receive some helpful information and begin to receive our periodic newsletter to help you stay up-to-date.

Membership to the program is free to any interested citizen, family, or organization. Once you have a "Team" and a stream, you're set! You can determine your stream's values and problems, and you can plan projects based on your assessments. You establish the course of events in protecting your stream. The Maine Stream Team Program will help you with ideas, advice, and informational materials.

Contact The Maine Stream Team Program (MSTP):

Mail: Maine Stream Team Program, c/o Maine DEP, 312 Canco Road, Portland, ME 04103

E-mail: mstp@maine.gov

Internet: http://www.maine.gov/dep/blwq/docstream/team/streamteam.htm

Phone: (888)769-1036 (toll free – ask for the Maine Stream Team Program); (207)822-6317 [Jeff Varricchione, Portland, coordinator]; (207)822-6331 [Erin Crowley, Portland, Americorps volunteer]; (207) 287-7729 [Mary-Ellen Dennis, Augusta]; (207)941-4566 [Mark Whiting, Bangor]

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